PATENT ABSTRACTS OF JAPAN

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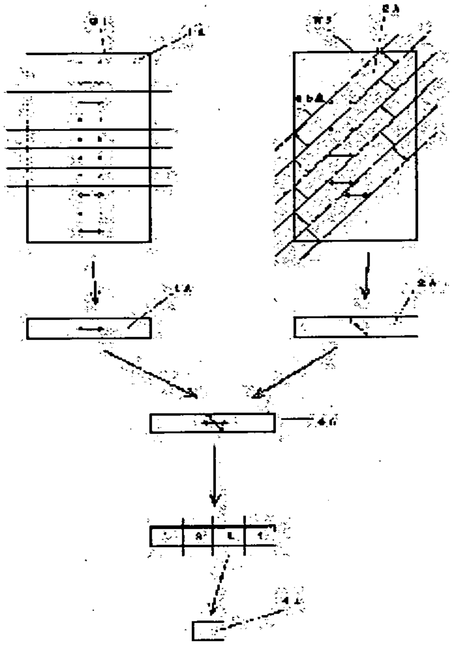
(54) PRODUCTION OF OPTICAL LOW-PASS FILTER

(57)Abstract:

PROBLEM TO BE SOLVED: To provide a process for producing an optical low-pass filter having high production efficiency.
SOLUTION: This process consists of a stage for cutting a rectangular quartz crystal double refractive plate group 1A from which plural sheets of quartz crystal double refractive plates may be cut out and of which one side is nearly parallel with an optical axis out of a quartz crystal wafer W1, a stage for cutting at least one kind of the rectangular quartz crystal double refractive plate group 2A from which plural sheets of the quartz crystal double refractive plates may be cut out, of which one side is deviated by a prescribed angle from the optical axis and is non-parallel with the optical axis out of a quartz crystal wafer W2, a stage for obtaining the optical low-pass filter groove 4A by sticking the quartz crystal double refractive plate group 1A nearly parallel with the optical axis and the quartz crystal double refractive plate group 2A non-parallel with at least one optical axis to each other and a stage for obtaining the optical filters 4a by sub-dividing the optical low-pass filter group 4A to a prescribed size.



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CLAIMS

[Claim(s)]
[Claim 1]A process of starting a crystal birefringent plate group of rectangular shape in which one side which can cut down two or more crystal birefringent plates is almost parallel to an optical optic axis from a crystal wafer, A prescribed angle degree one side which can cut down two or more crystal birefringent plates from an optical optic axis A process of starting a crystal birefringent plate group of at least one sort of rectangular shape which is non parallel from a crystal wafer to a shifted optical optic axis, A process of pasting together mutually a crystal birefringent plate group almost parallel to said optical axis, and a crystal birefringent plate group un-parallel to at least one optical optic axis, and obtaining an optical low pass filter group, A manufacturing method of an optical low pass filter which consists of a process of carrying out splitting-into-small-pieces cutting of said optical low pass filter group at a prescribed dimension, and obtaining a light filter.
[Claim 2]A predetermined optical optic axis which carried out angle crookedness has a crystal birefringent plate group of an approximate circle plate form which has at least one notching portion which is non parallel from a notching portion almost parallel to an optical optic axis, and this notching portion, So that a process of starting two or more of these crystal birefringent plate groups from a crystal wafer, and predetermined light separating may be made into a notching portion parallel to an optical optic axis of said crystal birefringent plate group. A process of coinciding a notching portion un-parallel to said optical optic axis, piling up two or more crystal birefringent plate groups, pasting together mutually, and obtaining an optical low pass filter group, A manufacturing method of an optical low pass filter which consists of a process of carrying out splitting-into-small-pieces cutting of said optical low pass filter group at a prescribed dimension, and obtaining a light filter.

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DETAILED DESCRIPTION

[Detailed Description of the Invention]
[0001]
[Industrial Application]This invention relates to the light filter used for the imaging device of a video camera or an electronic "still" camera, and relates to the manufacturing method of the miniaturized optical low pass filter especially corresponding to the miniaturization of the imaging device in recent years. The common video camera comprises a photographic subject side vertically on an optical optic axis in order of imaging devices, such as a coupling optical system, an optical low pass filter, a color separation filter, and CCD. When an imaging device filters the optical false signal detected accidentally, an optical low pass filter is used in order to prevent the image quality degradation of a video camera.
[0002]
[Description of the Prior Art]The 1st crystal birefringent plate constituted so that an optical low pass filter might pile up several crystal birefringent plates which changed the direction of an optical optic axis, and might be constituted, for example, an optical optic axis might be located horizontally, The 2nd crystal birefringent plate constituted so that an optical optic axis might predetermined-angle(for example, 45 degrees)-incline from a horizontal direction and it might be located, and if needed, an infrared removal filter etc. are piled up and it is constituted. As a manufacturing method of such an optical low pass filter, Conventionally each component parts (said 1st crystal birefringent plate, said 2nd crystal birefringent plate, etc.) one by one A specified dimension of the optical low pass filter as a final product. After starting (for a specified dimension to be called hereafter), said each component parts (the 1st crystal birefringent plate, the 2nd crystal birefringent plate, etc.) were pasted together one by one.
[0003]
[Problem(s) to be Solved by the Invention]However, in the conventional manufacturing method, in order to make each crystal birefringent plate into which the optical optic axis was changed one by one and to paste them together one by one, working efficiency was bad, and in order for a process of operation to also increase, there was a problem the field on manufacture. Leased facility was needed by polish etc. and it had the problem of becoming a cost hike as the miniaturization progressed.
[0004]It was made in order that this invention might solve the above-mentioned problem, and it aims at providing the manufacturing method of an optical low pass filter with high manufacturing efficiency.
[0005]
[Means for Solving the Problem]In order to solve the above-mentioned problem, a manufacturing method of an optical low pass filter by this invention, A process of starting a crystal birefringent plate group of rectangular shape in which one side which can cut down two or more crystal birefringent plates is almost parallel to an optical optic axis from a crystal wafer, A prescribed angle degree one side which can cut down two or more crystal birefringent plates from an optical optic axis A process of starting a crystal birefringent plate group of at least one sort of rectangular shape which is non parallel from a crystal wafer to a shifted optical optic axis, A process of pasting together mutually a crystal birefringent plate group almost parallel to said optical axis, and a crystal birefringent plate group un-parallel to at least one optical optic axis, and obtaining an optical low pass filter group, It is a manufacturing method of an optical low pass filter which consists of a process of carrying out splitting-into-small-pieces cutting of said optical low pass filter group at a prescribed dimension, and obtaining a light filter.
[0006]A predetermined optical optic axis which carried out angle crookedness has a crystal birefringent plate group of an approximate circle plate form which has at least one notching portion which is non parallel from a notching portion almost parallel to an optical optic axis, and this notching portion, So that a process of starting two or more of these crystal birefringent plate groups from a crystal wafer, and predetermined light separating may be made into a notching portion parallel to an optical optic axis of

said crystal birefringent plate group. A process of coinciding a notching portion un-parallel to said optical optic axis, piling up two or more crystal birefringent plate groups, pasting together mutually, and obtaining an optical low pass filter group, It may be a manufacturing method of an optical low pass filter which consists of a process of carrying out splitting-into-small-pieces cutting of said optical low pass filter group at a prescribed dimension, and obtaining a light filter.

[0007]

[Function]By the application-for-patent paragraph 1, since a crystal birefringent plate group also has few cutting parts greatly compared with one crystal birefringent plate (specified dimension), logging from a crystal wafer can perform it efficiently and easily. a crystal birefringent plate parallel to an optical optic axis — and — said — since the lamination of an un-parallel crystal birefringent plate group also has a large adhesion area compared with one crystal birefringent plate (specified dimension) and its work is large, workability is good. And while alignment accuracy improves further, it can carry out efficiently and easily. Since two or more light filters are obtained by the specified dimension of a request of an optical low pass filter group by carrying out splitting-into-small-pieces cutting, the manufacturing efficiency as the whole improves.

[0008]By the application-for-patent paragraph 2, so that predetermined light separating may be made into a notching portion parallel to the optical optic axis of said crystal birefringent plate group. Since coincide a notching portion un-parallel to an optical optic axis, two or more crystal birefringent plate groups are piled up, it pastes together mutually and an optical low pass filter group is obtained, light separating more than a 2-way can be performed only by preparing one kind of crystal birefringent plate group. And since this crystal birefringent plate group also has few cutting parts greatly compared with one crystal birefringent plate, logging from a crystal wafer can perform it efficiently and easily. Since the lamination of a crystal birefringent plate group also has a large adhesion area compared with one crystal birefringent plate and its work is large, workability is good. And while alignment accuracy improves further, it can carry out efficiently and easily. Since two or more light filters are obtained by the size of a request of an optical low pass filter group by carrying out splitting-into-small-pieces cutting, the manufacturing efficiency as the whole improves. moreover — since the crystal birefringent plate group is made into approximate circle plate shape, even if it skips a slight-chamfering process, since there is little generating of KAKE, chipping, etc., improvement in profile irregularity is easy — process simple ** — it is simultaneously realizable.

[0009]

[Example]Next, the 1st example of this invention is described with reference to drawings, making the optical low pass filter of a board into an example 45 degrees. Drawing 1 is a figure which illustrates the manufacturing process of an optical low pass filter in the 1st example of this invention. And drawing 2 is a sectional view of the typical optical low pass filter which consists of combination of a crystal birefringent plate and an infrared absorption filter. For example, with devices, such as a slicing machine (periphery gear-tooth cutting machine), from 77.5 mm long and the 32.7 mm wide (optical axis direction) crystal wafer W1 in a direction parallel to an optic axis. And the 1st ten crystal birefringent plate groups 1A (mm [long / 7.3], 32.7 mm (optical axis direction) wide) started by rectangular shape are obtained. The cutting width of a slicing machine (periphery gear-tooth cutting machine) is 0.5 mm. With devices, such as said another crystal wafer W2 (sizes other than thickness presuppose that it is the same as that of W1) to a slicing machine (periphery gear-tooth cutting machine), it is the direction rotated 45 degrees from the optic axis, and said 1st crystal birefringent plate group 1A and the 2nd five crystal birefringent plate groups 2A of the size are obtained with rectangular shape. While said 1st crystal birefringent plate group 1A started as mentioned above and said 2nd crystal birefringent plate group 2A perform a slight chamfering process, they perform polish and polishing processing and the principal surface is processed on the mirror plane. Although it is arranged between said 1st crystal birefringent plate group 1A and said 2nd crystal birefringent plate group 2A, for example, the infrared-absorption filter group which consists of phosphate glass is not illustrated, either, it is formed with 7.3 mm long and a 32.7-mm-wide size with rectangular shape like said each crystal birefringent plate group. Although the thickness of a crystal birefringent plate changes with optical specifications demanded, as for the thickness of the 1st crystal birefringent plate group, 0.86 mm and the infrared-absorption filter of it of 1.22 mm and the 2nd crystal birefringent plate group are 1.6 mm, for example. And it pastes together using ultraviolet curing type adhesives in the turn of the 1st crystal birefringent plate group, an infrared-absorption filter group, and the 2nd crystal birefringent plate group, and the optical low pass filter group 4A is constituted. And further, with devices, such as a slicing machine (periphery gear-tooth cutting machine), the optical low pass filter group 4A constituted as mentioned above is rectangular shape, is started, for example with 7.3 mm long and a 7.8 mm wide (optical axis direction) size, and obtains the four optical low pass filters 4a. The section of the light filter completed as shown in drawing 2 consists of the 1st crystal birefringent plate layer 1, the infrared-absorption filter layer 3, and the 2nd crystal birefringent plate layer 2.

[0010]Next, the manufacturing method of the optical low pass filter by the 2nd example of this invention is explained with reference to drawings. Drawing 3 is a figure which illustrates the manufacturing process of an optical low pass filter in the 2nd example of this invention. For example, with devices, such as a slicing machine (periphery gear-tooth cutting machine), from 77.5 mm long and the 32.7 mm wide (optical axis direction) crystal wafer W1 in a direction parallel to an optic axis. And the 1st five crystal birefringent plate groups 1B (mm [long / 15.1], 32.7 mm (optical axis direction) wide) started by rectangular shape are obtained. The cutting width of a slicing machine (periphery gear-tooth cutting machine) is 0.5 mm. It is the direction rotated 45 degrees from the optic axis with devices, such as said another crystal wafer W2 (sizes other than thickness presuppose that it is the same as that of W1) to a slicing machine (periphery gear-tooth cutting machine), And said 1st crystal birefringent plate group 1B, and 2nd crystal birefringent plate group 2B of the size and the 3rd crystal birefringent plate group 5B are obtained with rectangular shape. Said 1st crystal birefringent plate group 1B started as mentioned above, said 2nd crystal birefringent plate group 2B, and the 3rd crystal birefringent plate group 5B perform a slight chamfering process, and they perform polish and polishing processing and the principal surface is processed on the mirror plane. Although it is arranged between said 1st crystal birefringent plate group 1B and said 2nd crystal birefringent plate group 2B, for example, the infrared-absorption filter group which consists of phosphate glass is not illustrated, either, it is formed with 15.1 mm long and a 32.7-mm-wide size with rectangular shape like said each crystal birefringent plate group. Although the thickness of a crystal birefringent plate changes with optical specifications demanded, as for the thickness of the 1st crystal birefringent plate group, 0.86 mm and the infrared-absorption filter of it of the 1.22-mm, 2nd, and 3rd crystal birefringent plate group are 1.6 mm, for example. And it pastes together using ultraviolet curing type adhesives in the turn of the 1st crystal birefringent plate group, an infrared-absorption filter group, the 2nd crystal birefringent plate group, and the 3rd crystal birefringent plate group, and the optical low pass filter group 4B is constituted. And further, with devices, such as a slicing machine (periphery gear-tooth cutting machine), the optical low pass filter group 4B constituted as mentioned above is rectangular shape, is started, for example with 7.3 mm long and a 7.8 mm wide (optical axis direction) size, and obtains the eight optical low pass filters 4b.

[0011]Next, the manufacturing method of the optical low pass filter by the 3rd example of this invention is explained with reference to drawings. Drawing 4 is a figure which illustrates the manufacturing process of an optical low pass filter in the 3rd example of this invention. For example, by processing a periphery with devices, such as a core picking machine, from 77.5 mm long and 37.5 mm wide (optical axis direction) crystal wafer W3 (a slight chamfering process may also be performed in this case), the two crystal birefringent plate groups 1C (about 36 mm in diameter) and 2C (about 36 mm in diameter) started by disc shape being obtained, and, The 1st notching portion 11c and 21c of a straight line parallel to an optical optic axis is formed, and the 2nd linear notching portion 12c and 22c is formed so that the inside may be 135 degrees following this notching portion on the right-hand side of the 1st notching portion 11c and 21c of this straight line. The cage hulas 13c and 23c which show an optical axis direction are formed in said each crystal birefringent plate group. And polish and polishing processing are performed and the principal surface is processed on a mirror plane. And it pastes together using ultraviolet curing type adhesives in the turn of the crystal birefringent plate group 1C and the crystal birefringent plate group 2C, and an optical low pass filter group is constituted. It pastes together so that the field of the 1st notching portion 11c of the crystal birefringent plate group 1C and the 2nd notching portion 22c of the crystal birefringent plate group 2C may be piled up and an optic axis may specifically cross the crystal birefringent plate group 2C 45 degrees under the crystal birefringent plate group 1C, and the optical low pass filter group 4C is constituted. And further, with devices, such as a slicing machine (periphery gear-tooth cutting machine), the optical low pass filter group 4C constituted as mentioned above is rectangular shape, is started, for example with 7.3 mm long and a 7.8 mm wide (optical axis direction) size, and obtains the 12 optical low pass filters 4c. In the 3rd example, an infrared-absorption filter group may be arranged between each crystal birefringent plate group.

[0012]Next, the manufacturing method of the optical low pass filter by the 4th example of this invention is explained with reference to drawings. Drawing 5 is a figure which illustrates the manufacturing process of an optical low pass filter in the 4th example of this invention. For example, by processing a periphery with devices, such as a core picking machine, from 67 mm long and the 35 mm wide (optical axis direction) crystal wafer W4 (a slight chamfering process may also be performed in this case), the crystal birefringent plate group 1D (about 36 mm in diameter) started by approximate circle plate shape (it has a straight line by the edge of a crystal wafer, etc.), 2D (about 36 mm in diameter), and 5D (about 36 mm in diameter), [obtain and] The 1st linear notching portion 11d, 21d, and 51d parallel to an optical optic axis, And the 5th notching portion 15d, 25d, and 55d is formed, and the 2nd linear notching portion 12d, 22d, and 52d is formed so that the inside may be 135 degrees following this notching portion on the right-hand side of the 1st notching portion of this straight line. And the 4th linear notching portion 14d, 24d, and 54d is formed so that the inside may be 135 degrees following this notching portion on the left-hand side of the 5th notching portion. The 3rd linear notching portion 13d, 23d, and 53d is formed so that the inside may be 135 degrees following each notching portion between said 2nd notching portion and said 4th notching portion. These notching portions 13d, 23d, and 53d play a role of a cage hula which shows an optical axis direction. And polish and polishing processing are performed and the principal surface is processed on a mirror plane. And it pastes together using ultraviolet curing type adhesives in the turn of the crystal birefringent plate group 1D, crystal birefringent plate group 2D, and the crystal birefringent plate group 5D, and an optical low pass filter group is constituted. Crystal birefringent plate group 2D under the crystal birefringent plate group 1D specifically 11 d of 1st notching portion of the crystal birefringent plate group 1D, While pasting together so that the field of 22 d of 2nd notching portion of crystal birefringent plate group 2D may be doubled and an optic axis may cross 45 degrees, Under crystal birefringent plate group 2D, the crystal birefringent plate group 5D is pasted together so that the field of 23 d of 3rd notching portion of crystal birefringent plate group 2D and 51 d of 1st notching portion of the crystal birefringent plate group 5D may be doubled and an optic axis may cross 45 degrees, and the optical low pass filter group 4D is constituted. And further, with devices, such as a slicing machine (periphery gear-tooth cutting machine), the optical low pass filter group 4D constituted as mentioned above is started with rectangular shape with 7.3 mm long and a 7.8 mm wide (optical axis direction) size, and obtains the 12 optical low pass filters 4d. Since reduction of a substantial size can be aimed at by increasing the notching portion compared with said 3rd example, the shape by the 4th example of this invention can be used even if it makes the size of a crystal wafer small. Also in the 4th example, an infrared-absorption filter group may be arranged between each crystal birefringent plate group.

[0013]In the above-mentioned example, although the combination of a crystal birefringent plate and an infrared-absorption filter was illustrated, it is applicable also to the optical low pass filter which consists of combination of the various filter elements in which 1/4 wavelength plate etc. were intermingled, for example. In the above-mentioned example, although the optical low pass filter of the board was illustrated 45 degrees, it is not limited to these optical low pass filters, and can apply also to the optical low pass filter of a board 30 degrees, for example.

[0014]

[Effect of the Invention]By the application-for-patent paragraph 1, since a crystal birefringent plate group also has few cutting parts greatly compared with one crystal birefringent plate (specified dimension), logging from a crystal wafer can perform it efficiently and easily. a crystal birefringent plate parallel to an optical optic axis -- and -- said -- since the lamination of an un-parallel crystal birefringent plate group also has a large adhesion area compared with one crystal birefringent plate (specified dimension) and its work is large, workability is good. And while alignment accuracy improves further, it can carry out efficiently and easily. Since two or more light filters are obtained by the specified dimension of a request of an optical low pass filter group by carrying out splitting-into-small-pieces cutting, the manufacturing efficiency as the whole improves.

[0015]By the application-for-patent paragraph 2, so that predetermined light separating may be made into a notching portion parallel to the optical optic axis of said crystal birefringent plate group. Since coincide a notching portion un-parallel to an optical optic axis, two or more crystal birefringent plate groups are piled up, it pastes together mutually and an optical low pass filter group is obtained, light separating more than a 2-way can be performed only by preparing one kind of crystal birefringent plate group. And since this crystal birefringent plate group also has few cutting parts greatly compared with one crystal birefringent plate, logging from a crystal wafer can perform it efficiently and easily. Since the lamination of a crystal birefringent plate group also has a large adhesion area compared with one crystal birefringent plate and its work is large, workability is good. And while alignment accuracy improves further, it can carry out efficiently and easily. Since two or more light filters are obtained by the size of a request of an optical low pass filter group by carrying out splitting-into-small-pieces cutting, the manufacturing efficiency as the whole improves. moreover -- since the crystal birefringent plate group is made into approximate circle plate shape, even if it skips a slight-chamfering process, since there is little generating of KAKE, chipping, etc., improvement in profile irregularity is easy -- process simple ** -- it is simultaneously realizable.

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DESCRIPTION OF DRAWINGS

[Brief Description of the Drawings]
[Drawing 1]It is a figure which illustrates the manufacturing process of an optical low pass filter in the 1st example of this invention.
[Drawing 2]It is a sectional view of the typical optical low pass filter which consists of combination of a crystal birefringent plate and an infrared-absorption filter.
[Drawing 3]It is a figure which illustrates the manufacturing process of an optical low pass filter in the 2nd example of this invention.
[Drawing 4]It is a figure which illustrates the manufacturing process of an optical low pass filter in the 3rd example of this invention.
[Drawing 5]It is a figure which illustrates the manufacturing process of an optical low pass filter in the 4th example of this invention.
[Description of Notations]
1A and 1B ... the -- the crystal birefringent plate group of one
2A and 2B ... the -- the crystal birefringent plate group of two
1C, 1D, 2C, 2D, 5D ... Crystal birefringent plate group
3 ... Infrared absorbing glass
4A, 4B, 4C, 4D ... Optical low pass filter group
4a, 4b, 4c, 4d ... Optical low pass filter
5B ... the -- the crystal birefringent plate group of three

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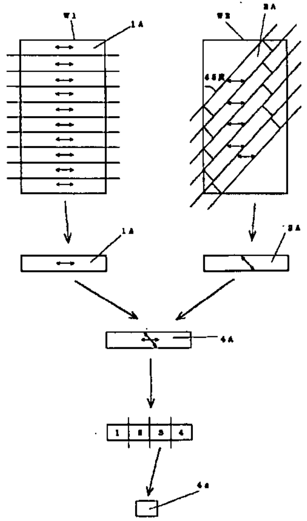
(54)【発明の名称】　光学ローパスフィルタの製造方法

(57)【要約】

【目的】　製造効率の高い光学ローパスフィルターの製造方法を提供することを目的とするものである。

【構成】　水晶複屈折板を複数枚切り出せる一辺が光学的光軸にほぼ平行な矩形状の水晶複屈折板群１Ａを水晶ウエハーＷ１から切り出す工程と、水晶複屈折板を複数枚切り出せる一辺を光学的光軸から所定角度ずらした光学的光軸に非平行な少なくとも１種の矩形状の水晶複屈折板群２Ａを水晶ウエハーＷ２から切り出す工程と、前記光学軸にほぼ平行な水晶複屈折板群１Ａと少なくとも１つの光学的光軸に非平行な水晶複屈折板群２Ａを互いに張り合わせて光学ローパスフィルタ群４Ａを得る工程と、前記光学ローパスフィルタ群４Ａを所定寸法に小割切断して光学フィルタ４ａを得る工程からなるものである。



【特許請求の範囲】

【請求項１】　水晶複屈折板を複数枚切り出せる一辺が光学的光軸にほぼ平行な矩形状の水晶複屈折板群を水晶ウエハーから切り出す工程と、水晶複屈折板を複数枚切り出せる一辺を光学的光軸から所定角度ずらした光学的光軸に非平行な少なくとも１種の矩形状の水晶複屈折板群を水晶ウエハーから切り出す工程と、前記光学軸にほぼ平行な水晶複屈折板群と少なくとも１つの光学的光軸に非平行な水晶複屈折板群を互いに張り合わせて光学ローパスフィルタ群を得る工程と、前記光学ローパスフィルタ群を所定寸法に小割切断して光学フィルタを得る工程からなる光学ローパスフィルタの製造方法。

【請求項２】　光学的光軸にほぼ平行な切り欠き部分と、この切り欠き部分から所定の角度屈曲させた光学的光軸に非平行な少なくとも１つの切り欠き部分を有する略円板形の水晶複屈折板群が有り、これら水晶複屈折板群を水晶ウエハーから複数枚切り出す工程と、所定の光分離がなされるよう前記水晶複屈折板群の光学的光軸に平行な切り欠き部分に、前記光学的光軸に非平行な切り欠き部分を一致させ、２以上の水晶複屈折板群を重ね合わせ、互いに張り合わせて光学ローパスフィルタ群を得る工程と、前記光学ローパスフィルタ群を所定寸法に小割切断して光学フィルタを得る工程からなる光学ローパスフィルタの製造方法。

【発明の詳細な説明】

【０００１】

【産業上の利用分野】本発明はビデオカメラや電子スチルカメラの撮像装置に用いられる光学フィルタに関するものであり、特に近年の撮像装置の小型化に対応した小型化された光学ローパスフィルタの製造方法に関するものである。一般的なビデオカメラは、光学的光軸上に垂直に被写体側より結合光学系、光学ローパスフィルタ、色分解フィルタ、ＣＣＤ等の撮像デバイスの順で構成されている。光学ローパスフィルタは、撮像デバイスが誤って検出する光学的疑似信号を濾波することにより、ビデオカメラの画質低下を防止するために用いられる。

【０００２】

【従来の技術】光学ローパスフィルタは、光学的光軸の方向を異ならせた複数の水晶複屈折板を重ね合わせて構成され、例えば、光学的光軸が水平方向に位置するよう構成された第１の水晶複屈折板と、光学的光軸が水平方向から所定角度（例えば４５度）傾いて位置するよう構成された第２の水晶複屈折板と、必要に応じて赤外線除去フィルタ等を重ね合わせて構成されている。このような光学ローパスフィルタの製造方法としては、従来、各構成部品（前記第１の水晶複屈折板、前記第２の水晶複屈折板等）を一つ一つ最終製品としての光学ローパスフィルタの規定寸法（以下、規定寸法と称す）に切り出した後、前記各構成部品（第１の水晶複屈折板、第２の水晶複屈折板等）を一つ一つ張り合わせていた。

【０００３】

【発明が解決しようとする課題】しかしながら、従来の製造方法では、光学的光軸を変えた各水晶複屈折板を一つ一つ作りだし、それらを一つ一つ張り合わせるため作業効率が悪く、作業工程も増えるため、製造上の面で問題があった。また、小型化が進むにつれ、研磨などで専用設備が必要となり、コストアップになるという問題点を有していた。

【０００４】本発明は上記問題点を解決するためになされたもので、製造効率の高い光学ローパスフィルターの製造方法を提供することを目的とするものである。

【０００５】

【課題を解決するための手段】上記問題点を解決するために、本発明による光学ローパスフィルタの製造方法は、水晶複屈折板を複数枚切り出せる一辺が光学的光軸にほぼ平行な矩形状の水晶複屈折板群を水晶ウエハーから切り出す工程と、水晶複屈折板を複数枚切り出せる一辺を光学的光軸から所定角度ずらした光学的光軸に非平行な少なくとも１種の矩形状の水晶複屈折板群を水晶ウエハーから切り出す工程と、前記光学軸にほぼ平行な水晶複屈折板群と少なくとも１つの光学的光軸に非平行な水晶複屈折板群を互いに張り合わせて光学ローパスフィルタ群を得る工程と、前記光学ローパスフィルタ群を所定寸法に小割切断して光学フィルタを得る工程からなる光学ローパスフィルタの製造方法である。

【０００６】また、光学的光軸にほぼ平行な切り欠き部分と、この切り欠き部分から所定の角度屈曲させた光学的光軸に非平行な少なくとも１つの切り欠き部分を有する略円板形の水晶複屈折板群が有り、これら水晶複屈折板群を水晶ウエハーから複数枚切り出す工程と、所定の光分離がなされるよう前記水晶複屈折板群の光学的光軸に平行な切り欠き部分に、前記光学的光軸に非平行な切り欠き部分を一致させ、２以上の水晶複屈折板群を重ね合わせ、互いに張り合わせて光学ローパスフィルタ群を得る工程と、前記光学ローパスフィルタ群を所定寸法に小割切断して光学フィルタを得る工程からなる光学ローパスフィルタの製造方法であってもよい。

【０００７】

【作用】特許請求項１により、水晶複屈折板群は一つの水晶複屈折板（規定寸法）に較べて大きく切断箇所も少ないことから水晶ウエハーからの切り出しが効率よくかつ容易に行える。また、光学的光軸に平行な水晶複屈折板、並びに同非平行な水晶複屈折板群の張り合わせも一つの水晶複屈折板（規定寸法）に較べて接着面積が大きく、ワークが大きいため作業性がよい。そしてさらに位置合わせ精度が向上するとともに効率よくかつ容易に行える。また、光学ローパスフィルタ群を所望の規定寸法に小割切断することにより複数の光学フィルタが得られるため全体としての製造効率が向上する。

【０００８】特許請求項２により、所定の光分離がなさ

れるよう前記水晶複屈折板群の光学的光軸と平行な切り欠き部分に、光学的光軸に非平行な切り欠き部分を一致させ、２以上の水晶複屈折板群を重ね合わせ、互いに張り合わせて光学ローパスフィルタ群を得ることから、１種類の水晶複屈折板群を用意するだけで２方向以上の光分離を行うことができる。そして、この水晶複屈折板群は一つの水晶複屈折板に較べて大きく切断箇所も少ないことから水晶ウエハーからの切り出しが効率よくかつ容易に行える。また、水晶複屈折板群の張り合わせも一つの水晶複屈折板に較べて接着面積が大きく、ワークが大きいため作業性がよい。そしてさらに位置合わせ精度が向上するとともに効率よくかつ容易に行える。また、光学ローパスフィルタ群を所望の寸法に小割切断することにより複数の光学フィルタが得られるため全体としての製造効率が向上する。また、水晶複屈折板群を略円板形状としていることから、糸面取り工程を省略しても、カケ、チッピング等の発生が少ないため、面精度の向上が容易であり、また工程簡略も同時に実現できる。

【０００９】

【実施例】次に、本発明の第１の実施例を４５度板の光学ローパスフィルタを例にしながら図面を参照して説明する。図１は本発明の第１の実施例で光学ローパスフィルタの製造工程を説明する図である。そして、図２は、水晶複屈折板と赤外線吸収フィルタとの組み合わせからなる模式的な光学ローパスフィルタの断面図である。例えば、縦７７．５㎜、横（光軸方向）３２．７㎜の水晶ウエハーＷ１からスライシングマシーン（外周歯切断機）などの装置により、光軸と平行の方向で、かつ、矩形状に切り出された第１の水晶複屈折板群１Ａ（縦７．３㎜、横（光軸方向）３２．７㎜）を１０枚得る。尚、スライシングマシーン（外周歯切断機）のカッティング幅は０．５㎜である。また、前記別の水晶ウエハーＷ２（厚さ以外の寸法はＷ１と同様とする）からスライシングマシーン（外周歯切断機）などの装置により、光軸から４５度回転させた方向で、かつ、矩形状で前記第１の水晶複屈折板群１Ａと同寸法の第２の水晶複屈折板群２Ａを５枚得る。以上のように切り出された前記第１の水晶複屈折板群１Ａと前記第２の水晶複屈折板群２Ａとは、糸面取り加工を施すとともに、研磨、ポリッシング加工を行い主面を鏡面に加工されている。また、前記第１の水晶複屈折板群１Ａと前記第２の水晶複屈折板群２Ａとの間に配置される、例えばリン酸ガラスからなる赤外吸収フィルタ群も、図示しないが、前記各水晶複屈折板群と同様に、矩形状で、縦７．３㎜、横３２．７㎜の寸法にて形成されている。尚、水晶複屈折板の厚さは要求される光学的仕様によって異なってくるが、例えば第１の水晶複屈折板群の厚さは１．２２㎜、第２の水晶複屈折板群のそれは０．８６㎜、赤外吸収フィルタは１．６㎜である。そして、第１の水晶複屈折板群、赤外吸収フィルタ群、第２の水晶複屈折板群の順番で紫外線硬化型の接着剤を用い、貼り合わせて光学ローパスフィルタ群４Ａを構成する。そして、以上のように構成された光学ローパスフィルタ群４Ａは、さらにスライシングマシーン（外周歯切断機）などの装置により、方形状で、例えば縦７．３㎜、横（光軸方向）７．８㎜の寸法で切り出し、光学ローパスフィルタ４ａを４枚得る。尚、図２に示すように完成された光学フィルタの断面は、第１の水晶複屈折板層１と赤外吸収フィルタ層３と第２の水晶複屈折板層２とからなる。

【００１０】次に、本発明の第２の実施例による光学ローパスフィルタの製造方法を図面を参照して説明する。図３は本発明の第２の実施例で光学ローパスフィルタの製造工程を説明する図である。例えば、縦７７．５㎜、横（光軸方向）３２．７㎜の水晶ウエハーＷ１からスライシングマシーン（外周歯切断機）などの装置により、光軸と平行の方向で、かつ、矩形状に切り出された第１の水晶複屈折板群１Ｂ（縦１５．１㎜、横（光軸方向）３２．７㎜）を５枚得る。尚、スライシングマシーン（外周歯切断機）のカッティング幅は０．５㎜である。また、前記別の水晶ウエハーＷ２（厚さ以外の寸法はＷ１と同様とする）からスライシングマシーン（外周歯切断機）などの装置により、光軸から４５度回転させた方向で、かつ、矩形状で前記第１の水晶複屈折板群１Ｂと同寸法の第２の水晶複屈折板群２Ｂ、第３の水晶複屈折板群５Ｂを得る。以上のように切り出された前記第１の水晶複屈折板群１Ｂと前記第２の水晶複屈折板群２Ｂと第３の水晶複屈折板群５Ｂとは、糸面取り加工を施すと共に、研磨、ポリッシング加工を行い主面を鏡面に加工されている。また、前記第１の水晶複屈折板群１Ｂと前記第２の水晶複屈折板群２Ｂとの間に配置される、例えばリン酸ガラスからなる赤外吸収フィルタ群も、図示しないが、前記各水晶複屈折板群と同様に、矩形状で、縦１５．１㎜、横３２．７㎜の寸法にて形成されている。尚、水晶複屈折板の厚さは要求される光学的仕様によって異なってくるが、例えば第１の水晶複屈折板群の厚さは１．２２㎜、第２、第３の水晶複屈折板群のそれは０．８６㎜、赤外吸収フィルタは１．６㎜である。そして、第１の水晶複屈折板群、赤外吸収フィルタ群、第２の水晶複屈折板群、第３の水晶複屈折板群の順番で紫外線硬化型の接着剤を用い、貼り合わせて光学ローパスフィルタ群４Ｂを構成する。そして、以上のように構成された光学ローパスフィルタ群４Ｂは、さらにスライシングマシーン（外周歯切断機）などの装置により、方形状で、例えば縦７．３㎜、横（光軸方向）７．８㎜の寸法で切り出し、光学ローパスフィルタ４ｂを８枚得る。

【００１１】次に、本発明の第３の実施例による光学ローパスフィルタの製造方法を図面を参照して説明する。図４は本発明の第３の実施例で光学ローパスフィルタの製造工程を説明する図である。例えば、縦７７．５㎜、横（光軸方向）３７．５㎜の水晶ウエハーＷ３から芯取り機などの装置で外周を加工（この際糸面取り加工も行っても良い）することにより、円板形状に切り出された水晶複屈折板群１Ｃ（直径約３６㎜），２Ｃ（直径約３６㎜）を２枚得て、そして、光学的光軸に平行な直線の第１の切り欠き部分１１ｃ，２１ｃを形成し、この直線の第１の切り欠き部分１１ｃ，２１ｃの右側にこの切り欠き部分に続いて内角が１３５度となるように直線の第２の切り欠き部分１２ｃ，２２ｃを形成する。また、前記各水晶複屈折板群には光軸方向を示すオリフラ１３ｃ，２３ｃが設けられている。そして、研磨，ポリッシング加工を行い主面を鏡面に加工する。そして、水晶複屈折板群１Ｃ、水晶複屈折板群２Ｃの順番で紫外線硬化型の接着剤を用い、貼り合わせて光学ローパスフィルタ群を構成する。具体的には、水晶複屈折板群１Ｃの下に水晶複屈折板群２Ｃを、水晶複屈折板群１Ｃの第１の切り欠き部分１１ｃと、水晶複屈折板群２Ｃの第２の切り欠き部分２２ｃの面を重ね、光軸が４５度交差するように貼り合わせて光学ローパスフィルタ群４Ｃを構成する。そして、以上のように構成された光学ローパスフィルタ群４Ｃは、さらにスライシングマシーン（外周歯切断機）などの装置により、方形状で、例えば縦７．３㎜、横（光軸方向）７．８㎜の寸法で切り出し、光学ローパスフィルタ４ｃを１２枚得る。尚、第３の実施例において、各水晶複屈折板群の間に赤外吸収フィルタ群を配置してもよい。

【００１２】次に、本発明の第４の実施例による光学ローパスフィルタの製造方法を図面を参照して説明する。図５は本発明の第４の実施例で光学ローパスフィルタの製造工程を説明する図である。例えば、縦６７㎜、横（光軸方向）３５㎜の水晶ウエハーＷ４から芯取り機などの装置で外周を加工（この際糸面取り加工も行っても良い）することにより、略円板形状（水晶ウエハの縁等による直線を有する）に切り出された水晶複屈折板群１Ｄ（直径約３６㎜），２Ｄ（直径約３６㎜），５Ｄ（直径約３６㎜）を得て、そして、光学的光軸に平行な直線の第１の切り欠き部分１１ｄ，２１ｄ，５１ｄ、並びに第５の切り欠き部分１５ｄ，２５ｄ，５５ｄを形成し、この直線の第１の切り欠き部分の右側にこの切り欠き部分に続いて内角が１３５度となるように直線の第２の切り欠き部分１２ｄ，２２ｄ，５２ｄを形成する。そして、第５の切り欠き部分の左側にこの切り欠き部分に続いて内角が１３５度となるように直線の第４の切り欠き部分１４ｄ，２４ｄ，５４ｄを形成する。また、前記第２の切り欠き部分と、前記第４の切り欠き部分とのあいだに各切り欠き部分に続いて内角が１３５度となるように直線の第３の切り欠き部分１３ｄ，２３ｄ，５３ｄを形成する。この切り欠き部分１３ｄ，２３ｄ，５３ｄは光軸方向を示すオリフラとしての役割を果たす。そして、研磨，ポリッシング加工を行い主面を鏡面に加工する。そして、水晶複屈折板群１Ｄ、水晶複屈折板群２Ｄ、水晶複屈折板群５Ｄの順番で紫外線硬化型の接着剤を用い、貼り合わせて光学ローパスフィルタ群を構成する。具体的には、水晶複屈折板群１Ｄの下に水晶複屈折板群２Ｄを、水晶複屈折板群１Ｄの第１の切り欠き部分１１ｄと、水晶複屈折板群２Ｄの第２の切り欠き部分２２ｄの面を合わせて光軸が４５度交差するように貼り合わせるとともに、水晶複屈折板群２Ｄの下に水晶複屈折板群５Ｄを、水晶複屈折板群２Ｄの第３の切り欠き部分２３ｄと、水晶複屈折板群５Ｄの第１の切り欠き部分５１ｄの面を合わせて光軸が４５度交差するように貼り合わせて光学ローパスフィルタ群４Ｄを構成する。そして、以上のように構成された光学ローパスフィルタ群４Ｄは、さらにスライシングマシーン（外周歯切断機）などの装置により、方形状で縦７．３㎜、横（光軸方向）７．８㎜の寸法で切り出し、光学ローパスフィルタ４ｄを１２枚得る。尚、本発明の第４の実施例による形状は、前記第３の実施例にくらべて切り欠き部分が増やされていることにより、実質的な寸法の縮小がはかれるため、水晶ウエハの寸法を小さくしても利用できる。また、第４の実施例においても、各水晶複屈折板群の間に赤外吸収フィルタ群を配置してもよい。

【００１３】尚、上記実施例では、水晶複屈折板と赤外吸収フィルタとの組み合わせを例示したが、例えば１／４波長板等が混在した各種フィルタ素子の組み合わせからなる光学ローパスフィルタにも適用できるものである。また、上記実施例では、４５度板の光学ローパスフィルタを例示したが、これらの光学ローパスフィルタに限定されるものではなく、例えば３０度板の光学ローパスフィルタにも適用できるものである。

【００１４】

【発明の効果】特許請求項１により、水晶複屈折板群は一つの水晶複屈折板（規定寸法）に較べて大きく切断箇所も少ないことから水晶ウエハーからの切り出しが効率よくかつ容易に行える。また、光学的光軸に平行な水晶複屈折板、並びに同非平行な水晶複屈折板群の張り合わせも一つの水晶複屈折板（規定寸法）に較べて接着面積が大きく、ワークが大きいため作業性がよい。そしてさらに位置合わせ精度が向上するとともに効率よくかつ容易に行える。また、光学ローパスフィルタ群を所望の規定寸法に小割切断することにより複数の光学フィルタが得られるため全体としての製造効率が向上する。

【００１５】特許請求項２により、所定の光分離がなされるよう前記水晶複屈折板群の光学的光軸と平行な切り欠き部分に、光学的光軸に非平行な切り欠き部分を一致させ、２以上の水晶複屈折板群を重ね合わせ、互いに張り合わせて光学ローパスフィルタ群を得ることから、１種類の水晶複屈折板群を用意するだけで２方向以上の光分離を行うことができる。そして、この水晶複屈折板群は一つの水晶複屈折板に較べて大きく切断箇所も少ないことから水晶ウエハーからの切り出しが効率よくかつ容

易に行える。また、水晶複屈折板群の張り合わせも一つの水晶複屈折板に較べて接着面積が大きく、ワークが大きいため作業性がよい。そしてさらに位置合わせ精度が向上するとともに効率よくかつ容易に行える。また、光学ローパスフィルタ群を所望の寸法に小割切断することにより複数の光学フィルタが得られるため全体としての製造効率が向上する。また、水晶複屈折板群を略円板形状としていることから、糸面取り工程を省略しても、カケ、チッピング等の発生が少ないため、面精度の向上が容易であり、また工程簡略も同時に実現できる。

【図面の簡単な説明】

【図1】本発明の第1の実施例で光学ローパスフィルタの製造工程を説明する図である。

【図2】水晶複屈折板と赤外吸収フィルタとの組み合わせからなる模式的な光学ローパスフィルタの断面図である。

【図3】本発明の第2の実施例で光学ローパスフィルタの製造工程を説明する図である。

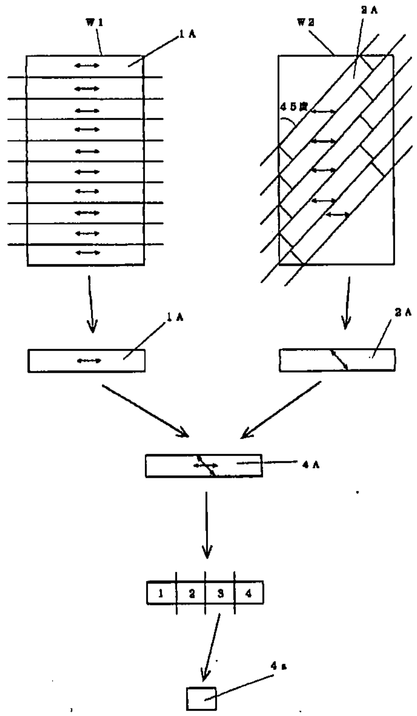
【図4】本発明の第3の実施例で光学ローパスフィルタの製造工程を説明する図である。

【図5】本発明の第4の実施例で光学ローパスフィルタの製造工程を説明する図である。

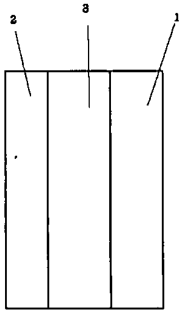
【符号の説明】

1A，1B・・・第1の水晶複屈折板群
2A，2B・・・第2の水晶複屈折板群
1C，1D，2C，2D，5D・・・水晶複屈折板群
3・・・赤外線吸収ガラス
4A，4B，4C，4D・・・光学ローパスフィルタ群
4a，4b，4c，4d・・・光学ローパスフィルタ
5B・・・第3の水晶複屈折板群

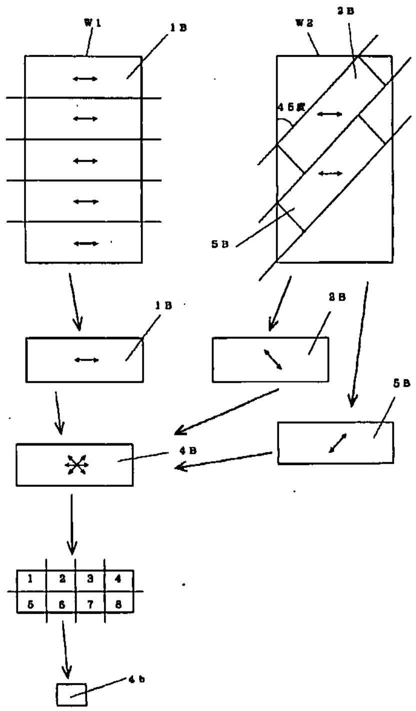
【図1】



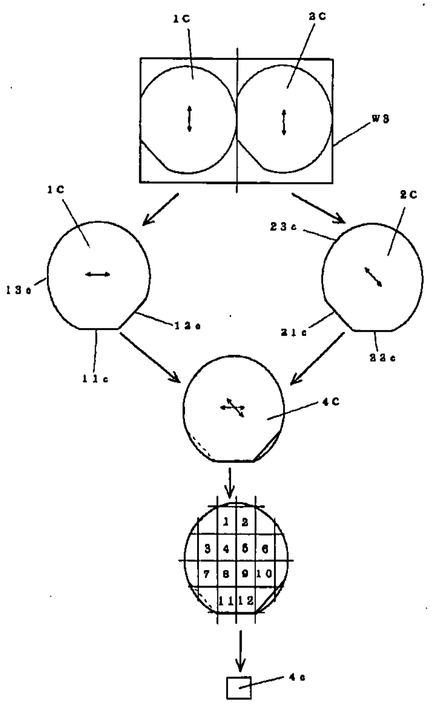
【図2】



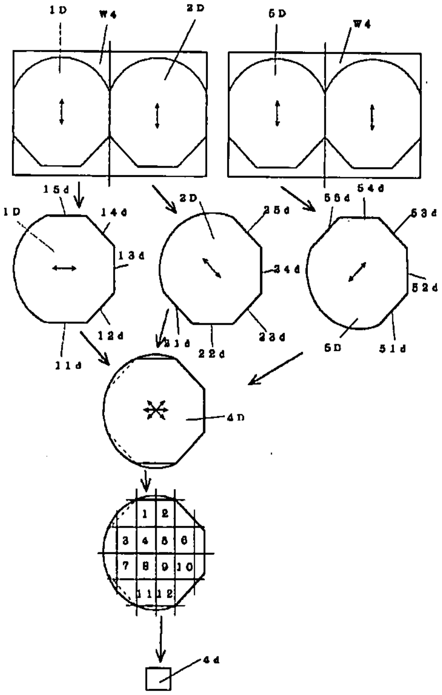
【図3】



【図4】


1C
2C
W3
1C
2C
4C
4c

【図5】


1D
W4
2D
5D
W4
1D
2D
5D
4D
4d